focus on

Air Quality

Introduction

Pollution: the act of polluting or the state of being polluted; filthy or disgusting.

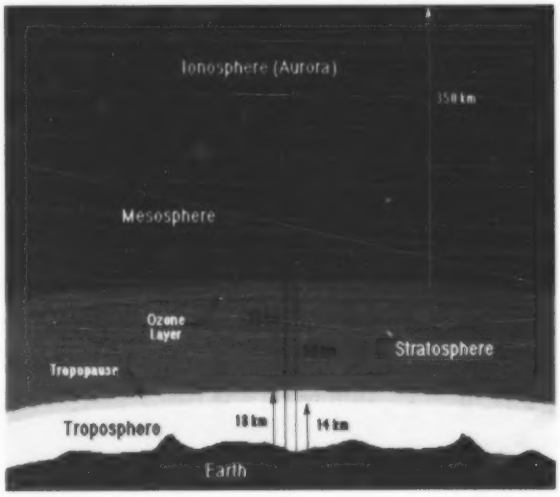
Standards: rules that limit the amount of pollution allowed into the environment.

Emissions: anything discharged into the soil, air, or water.

Air quality is a measure of the cleanliness of the air we breathe. Natural and man-made **pollution** gets into the air in the form of gases or particles. Healthy environmental systems and healthy people can tolerate a certain amount of pollution, but if the pollution levels get too high, the health of people and the environment can be at risk. The problem with air pollution is deciding how much is too much? In Alberta, the provincial government sets **standards** that help control air **emissions**.

Background

Life on Earth exists within a narrow band called the biosphere. The biosphere is made up of three parts: the lithosphere (rock and soil), the hydrosphere (water), and the atmosphere (air). Although the atmosphere extends several hundred kilometers into space, only the lower few kilometers have enough oxygen to support life.



Weather is the condition of the atmosphere at any particular time and place

The atmosphere is made up of four layers. The troposphere is the layer closest to the Earth, approximately 11 km high. **Weather** occurs only in the troposphere; this is the layer that contains most of the water vapour. The atmosphere is composed of a mixture of gases that are 78 per cent nitrogen, 21 per cent oxygen, 0.9 per cent argon, 0.03 per cent carbon dioxide, as well as traces of other gases.

The quality of our air is related to the composition of the gases and particles that make up our atmosphere. Human activities, such as the combustion of fossil fuels, are impacting the composition of the gases in our atmosphere and hence

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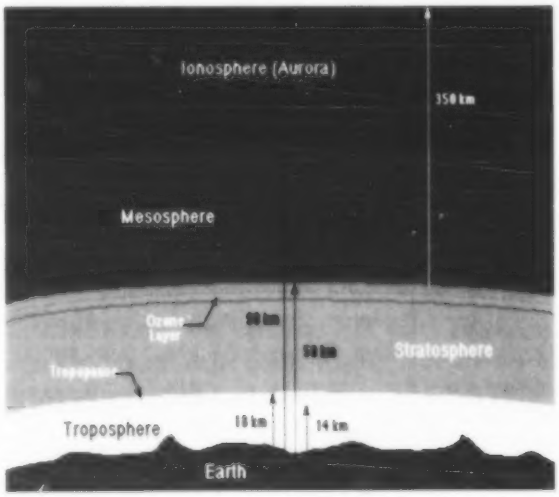

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impact the quality of our air. When we breathe air, our lungs absorb oxygen and exhale carbon dioxide. Plants, on the other hand, use the carbon dioxide and give off oxygen in a process called **photosynthesis.** Scientists believe that most of the oxygen in our atmosphere comes from plant photosynthesis.

Photosynthesis is a process by which green plants use sunlight energy to convert water and carbon dioxide into oxygen and organic compounds. It is the basis for virtually all life.

Air pollution from natural sources has been around for millions of years. Many scientists believe a large asteroid hit the earth causing the extinction of the dinosaurs. The collision created a cloud of dust that was so thick it cooled the earth, and the dinosaurs were not able to adapt to the new colder environment. Volcanic smoke, dust storms, and wild fires are all sources of "natural" air pollution.

Early humans contributed to air pollution by setting fires to drive game away clear land for agriculture, and keep warm. Early industrial cities in Europe and North America were among the most polluted environments created by human activities. People relied heavily on coal for power and heat. The thick black smoke from these fires hung over the cities and blackened exposed surfaces with soot. Other pollutants like sulphur dioxide and oxides of nitrogen were also present. By the 1950s people began to realize that pollution was affecting their health and the health of plants and animals.

On October 26, 1948. An air inversion in **Danora, Pennsylvania** trapped industrial air effluents in the valley. Over the next few days, 68 people died while hundreds more were left with permanent lung damage.

Today, many of the visible effects of air pollution have been eliminated. This is a result of changes in daily activities, such as replacing wood and coal heating with cleaner fuels like natural gas, which have reduced emissions. Industrial smokestacks must have dust collectors or scrubbers to reduce harmful emissions to the atmosphere; however, not all pollutants can be completely removed. Some emissions still enter the environment.

Air pollution

The constant movement and mixing of air masses allows the atmosphere to absorb a certain amount of air pollution. Emissions from vehicles, smokestacks, chimneys, and flare stacks are mixed with the air, diluted, and moved away. Poor air quality occurs when these emissions become too concentrated because conditions in the atmosphere disperse emissions too slowly, such as during an **inversion**. Sometimes, pollution levels build up in the atmosphere creating global problems (see ***Focus on Ozone Depletion*** and ***Focus on Climate Change***).

Normal air temperature cools as we move up through the atmosphere. An **inversion** occurs when the temperature rises with height instead of cooling. The warm air acts like a cap preventing the air from mixing.

Air pollution is a more serious problem in cities than it is in rural areas because there are more emission sources in cities. Vehicles are responsible for much of Alberta's urban air emissions while oil and gas processing, power plants, pulp mills, wood and paper processing, forestry and some agricultural activities contribute to rural air quality concerns.

To check out the air quality in your city visit: www3.gov.ab.ca/env/air/AmbientAirMonitoring/currentairquality.html

Common air pollutants

Air Quality Index
Alberta Environment measures the five major pollutants hourly and rates air quality based on the pollution level. The lower the pollution level, the lower the number and the better the air quality.

Listed below are the major pollutants, their characteristics and effects. Alberta Environment monitors these substances to determine the **Air Quality Index** for ambient air quality in Alberta.

- **Carbon Monoxide (CO):** is a colourless, odourless, tasteless gas produced by the incomplete combustion of fossil fuels, particularly in internal combustion engines. Carbon monoxide replaces oxygen in red blood cells, which reduces the amount of oxygen carried in blood, reducing brain functions and impairing other bodily functions. The symptoms of oxygen deprivation include drowsiness and impaired perception and thinking.

- **Ozone (O_3):** is formed by a reaction of sunlight on hydrocarbons and oxides of nitrogen. At extremely high ambient levels, ozone can have a pungent odour and a pale blue colour. Ozone is found naturally in the air and is necessary in the upper atmosphere. However, too high a concentration at ground level can be **toxic**, causing eye irritation, breathing difficulty, and vegetation damage. Ozone is a major component of summertime smog.

Toxic: of, or having a poisonous nature.

- **Fine Particulate Matter ($PM_{2.5}$):** are tiny particles of solid or liquid matter that remain suspended in the air in the form of mist, dust, aerosols, smoke, fumes, or soot. These fine particles can cause breathing difficulties in people with respiratory problems or cause eye irritation. Particles also slow down transpiration, thereby reducing plant growth. These particles are less than 2.5 micrometres in diameter. In comparison, a human hair is 70 micrometres in diameter.

- **Oxides of Nitrogen (NO_x):** are gases formed when nitrogen and oxygen combine under high temperatures. The main source of NO_x is the internal combustion engine. In the atmosphere, nitrogen oxide converts readily to nitrogen dioxide, a reddish-brown toxic gas. Nitrogen dioxide contributes to the formation of ground level ozone and smog and can mix with water to form acids. Oxides of nitrogen can affect health, suppress plant growth, and corrode metals. Nitrogen dioxide is one component of urban smog.

- **Sulphur Dioxide (SO_2):** is a colourless, acrid gas formed when sulphur and oxygen combine. The main sources of sulphur dioxide are burning fuels containing sulphur (coal and gasoline) and the removal of sulphur from natural gas and crude oil. Sulphur dioxide combines readily with water to form sulphuric acid. This acid can corrode metals, irritate the eyes and lungs, and damage vegetation. Sulphur dioxide is a major component of acid deposition (also known as acid rain).

Clean Air Strategic Alliance (CASA)

CASA is a non-government organization that is helping manage air quality issues in Alberta. CASA is a multi-stakeholder partnership made up of members from all levels of government, industry, non-government organizations, and interested public. Through a consensus process, CASA makes recommendations that are brought to the government for implementation. Since many air issues are local in nature, airshed zones have been established to look after air quality issues where appropriate. Local stakeholders can design solutions for local air quality issues.

Air quality control

The public, industry, and government have all recognized the need to control the amount and type of emissions put into the air. In Alberta, government and industry work together to measure and control emissions. A network of provincial stations monitor for carbon monoxide, ozone, oxides of nitrogen, sulphur dioxide, particulates, and many other pollutants.

In 2006, the Syncrude plant had air emission problems. Alberta Environment required the plant shut down until appropriate pollution controls could be implemented.

Government inspectors investigate when one or more of these emissions exceed established limits. If the emissions are from a specific industry, action is taken. The government works with industry to prevent further pollution problems by requiring improved operation of pollution control equipment or installing new pollution control devices. Failure to comply may result in the industry being fined or closed until the regulations are met.

If high pollution readings are the result of atmospheric conditions, the government may require all industries to restrict emissions or temporarily reduce operations. When conditions return to normal, the industries may start up again.

Air quality has improved in Alberta over the past decade. Improvements in technology have reduced emissions from vehicles and from oil and gas processing. All companies are required to use the best practical technology to reduce emissions. For example, companies burning coal must use filters to trap and remove particles before they enter the environment, and catalytic converters in cars newer than 1988 have significantly reduced air emissions.

Today's air quality concerns

Internal Combustion Engine: In spite of the many improvements to car and truck engines, vehicles are still a major contributor to air pollution in Alberta (a 2004 vehicle emits 95 per cent less pollution than a pre-1988 vehicle). This is

because there are more vehicles on Alberta roads every year. Exhaust fumes contain carbon monoxide, sulphur dioxide, oxides of nitrogen, and particulate matter. While a single engine emits only a small amount of pollutants, many vehicles together create significant air emissions.

Acid Deposition: occurs when sulphur dioxide and oxides of nitrogen are dispersed into the atmosphere. They mix with water in the atmosphere and then fall to the earth as precipitation, commonly referred to as acid rain. Some gases mix with particles in the air and fall as dry deposition. These gases become acids when they come in contact with soil moisture. For more information on acid deposition, see ***Focus On Acid Deposition.*** Sources of acid forming particles include the internal combustion engine, oil and natural gas processing, and smoke from the combustion of coal.

Climate Change: is a change in the earth's long-term weather patterns. Many scientists believe that greenhouse gas emissions like carbon dioxide and methane are building-up in the atmosphere. These gases trap heat in the lower layers of the earth's atmosphere, warming the planet. For more information on Climate Change, see ***Focus On Climate Change.***

What can you do?

In our day-to-day lives, each of us adds to air pollution - it is a byproduct of our daily activities. We all bear some responsibility and have a duty to reduce air pollution. As responsible citizens we need to:

- Use our vehicles less, plan our trips, purchase the appropriate size of vehicle, drive efficiently, idle less, take public transit, car pool, bike or walk
- Keep pollution control devices in good working order
- Conserve energy by turning off lights and using energy efficient appliances
- Reduce and recycle the material being processed

Smart choices benefit us all. Citizen action demonstrates concern and encourages governments to take action on pollution problems.

For more information

For more information on air quality issues in Alberta, visit the following websites:
Alberta Environment's air: www3.gov.ab.ca/env/air/index.html
CASA: www.casahome.org
Alberta Environment's State of the Environment:
www3.gov.ab.ca/env/soe/air.html

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